UNITED STATES MARINE CORPS
Logistics Operations School
Marine Corps Combat Service Support Schools
Training Command
PSC Box 20041
Camp Lejeune, North Carolina 28542-0041

MTMOC 2405

STUDENT OUTLINE

VEHICLE SELF-RECOVERY OPERATIONS

LEARNING OBJECTIVES:

1. Terminal Learning Objective: Given the reference material, equipment to be recovered, and personnel, direct vehicle self-recovery operations, per FM 21-305, FMFRP 4-34, and applicable

2. Enabling Learning Objectives: Given the reference material, equipment to be recovered, and personnel, per FM 21-305, FMFRP 4-34, and applicable equipment operator's manuals:

   a. Compute the total load resistance. (3510.1.7a)

   b. Identify safety requirements. (3510.1.7b)

   c. Direct crane operations. (3510.1.7c)

   d. Direct winching operations. (3510.1.7d)

   e. Direct recovery operations using mechanical anchors. (3510.1.7e)

   f. Direct recovery operations using natural anchors. (3510.1.7f)

   g. Direct vehicle towing operations. (3510.1.7g)

OUTLINE

1. FIELD EXPEDIENT REPAIRS: An expedient repair or measure is any method by which a task is accomplished using materials that are on hand; however, expedient repairs should only be used as a last resort in emergency situations. To prevent injury to personnel or more damage to equipment, an

assistant should always be available to the operator when field expedient measures are being employed.

a. Changing a Flat Tire on a 5-ton Truck Without a Jack

(1) Replacement of a flat front tire on a 5-ton vehicle can be accomplished as follows:

(a) First, the vehicle operator should make sure wheel chocks or rocks of sufficient size are available to chock the wheels once the vehicle is raised, and that the spare tire and wheel assembly has been positioned close to the vehicle.

(b) Now the parking brake should be engaged and then the lug nuts securing the wheel that has the flat tire should be loosened but not removed.

(c) Next, a timber about five feet long should be secured at an angle to the front bumper with a chain or rope. The timber should be placed off center of the front bumper in front of the frame rail on the side of the vehicle with the flat tire.

(d) Once the timber is secured to the front bumper, the bottom of the timber must be placed in a shallow hole to prevent it from moving when the vehicle is driven forward.

(e) The operator will release the parking brake and, watching the assistant, very carefully and slowly move the vehicle forward until the timber is in a vertical position and the wheel has cleared the ground.

(f) Now, the brakes must be set and the wheels chocked. Now, the flat tire and wheel assembly can be replaced with the spare assembly.

(g) Once the spare tire has been secured in position on the axle, the wheel chocks should be removed. The operator should slowly drive the vehicle in reverse until the tire is back on the ground and the stress has been removed off the timber.

(h) Finally, the operator must tighten the lug nuts and remove the timber from the front bumper.

(2) Changing a flat on the front or rear of a vehicle.

(a) First, the vehicle operator must find a piece of timber of sufficient strength that is longer than the distance from the bottom of the axle housing to the ground, and position the spare tire and wheel assembly close to the vehicle.

(b) Next, the operator should make sure wheel chocks or rocks of sufficient size are available to chock the wheels once the vehicle is raised.

(c) With all the required material at hand, the vehicle operator should loosen but not remove the lug nuts securing the wheel that has the flat tire.

(d) Next, he should wedge one end of the timber against the bottom of the axle at an angle and the other end in a shallow hole in the ground.

(e) Now watching the assistant, the vehicle operator should slowly drive the vehicle onto the timber until the wheel clears the ground.

(f) Once the wheel clears the ground, he should set the brakes and have the assistant chock the wheels.

(g) With the vehicle secured in place and the wheel off the ground, now he can remove the wheel and tire assembly and replace it with the spare tire.

(h) Once the spare has been positioned and secured to the axle, the wheel chock should be removed; and the vehicle operator should slowly move the vehicle forward or in reverse until the tire is on the ground and the piece of timber is no longer wedged under the axle.

(i) Finally, the vehicle operator should tighten the lug nuts.

b. M998 Series Vehicle Emergency Fan Clutch Override Service

(1) The radiator fan on the M998 Series vehicle engine normally activates when the engine temperature exceeds 220^{O} Fahrenheit which is within the normal operating range of 190^{O} to 230^{O} Fahrenheit and deactivates when engine temperature drops to 190^{O} Fahrenheit. If the engine overheats in an emergency situation the emergency fan clutch override service should be performed to ensure continuous fan operation.

(2) The emergency fan clutch override service is performed as follows:

(a) First, the vehicle operator should make sure the engine is stopped, the transmission is in neutral, and the parking brake is set.

(b) Next, he should raise and secure the hood.

(c) With the engine off and the hood raised, the time delay module connector must be disconnected from the control valve connector.

(d) Now the vehicle operator should start the engine, and check the fan for continuous operation.

1 If the fan does not operate continuously, the vehicle operator should shut down the engine and immediately notify his supervisor or unit maintenance section.

2 If the fan does operate continuously, the engine should be allowed to cool at an idle until the engine temperature lowers to a normal operating temperature of 190^{O} - 230^{O} Fahrenheit.

(e) After the completion of his mission, the vehicle should be turned into the unit maintenance section and they should be made aware of the emergency service performed on the vehicle.

c. M939 Series Vehicle Radiator Fan Clutch Emergency Service

(1) The radiator fan on the M939 Series vehicle engine normally activates when the engine coolant temperature exceeds 185^{O} Fahrenheit, which is within the normal operating range of 175^{O} Fahrenheit to 195^{O} Fahrenheit.

(a) Engine overheating is normally caused by damage to the thermostat that governs the operation of the cooling system fan.

(b) In an emergency situation the operator may, if unit maintenance personnel are not available, perform a radiator fan clutch emergency service.

(c) The operator can bypass the fan thermostat by securing the fan to the engine's fan clutch assembly. This procedure will be explained later in the lesson because there are a couple of other procedures that should be performed prior to the service.

(2) Symptoms of engine cooling system overheating.

(a) The engine coolant temperature exceeds 195^{O} Fahrenheit as so indicated by the engine coolant temperature gage.

(b) The engine coolant temperature has not decreased after the operator has stopped the vehicle and allowed the engine to idle. At this point, the operator will also check the following areas of the engine cooling system and take the appropriate corrective action:

1 Check the radiator core for obstructions, and if clogged, remove any debris.

2 Check the coolant level in the surge tank, and if low, add coolant to the surge tank to a level at the bottom of the surge tank fill neck.

3 Check for coolant leakage from surge tank, coolant hoses, and hose connections, and if loose, tighten the connections.

4 Remove the dipstick and check engine oil level, if low, add oil to the proper level.

5 Check radiator fan clutch operation, if the fan blade is not turning, shut down the engine and install the override lockup bolts.

(3) Radiator fan clutch emergency service.

(a) First, stop the engine by turning the ignition switch and battery switch to the "OFF" position. If anyone is in the vehicle's cab, make sure that they are aware of the danger in engaging these switches while the emergency service is being performed.

(b) Next, raise the hood and secure it in the up position. Make sure the retaining bar retaining pin is placed completely through the retaining bar once the bar is attached to the bumper bracket.

(c) Now remove the two clutch override lockup bolts from the storage boss on the fan clutch support bracket.

(d) With the storage bolts removed, line up the alinement mark on the side of the fan mounting plate with the alinement mark on the side of the fan clutch assembly. The fan mounting plate should turn freely by hand.

1 The alinement mark for the fan clutch assembly should be positioned at approximately three o'clock.

2 If the alinement mark for the clutch assembly is not in its proper location, without starting the engine, have an assistant tap the engine ignition switch to move the alinement mark to its proper position.

(e) With the alinement marks lined up, insert the two clutch override lockup bolts into the holes of the fan mounting plate and tighten the bolts by hand.

(f) Now, using the appropriate size wrench, tighten the override bolts until fully seated to secure the fan mounting plate to the fan clutch assembly.

(g) With the fan mounting plate secured to the clutch assembly, close and secure the hood.

(h) Now start the engine and allow the engine to cool at idle speed until the engine coolant temperature drops to a normal operating temperature range of 175^{O} Fahrenheit to 195^{O} Fahrenheit.

(i) Finally, as soon as possible, make certain your unit maintenance section is made aware of the emergency service performed on the vehicle.

d. Caging the Spring Brake Chambers

(1) The brakes on our tactical wheeled vehicles with a straight air brake system will automatically lock and stop the vehicle whenever a large loss of air pressure occurs. If this occurs and before the vehicle can be towed or moved off the road, the spring brakes must be manually released.

(2) The vehicle operator should manually release/cage the spring brakes only in an emergency to move the vehicle out of danger or to prevent an accident if the vehicle has stopped on the road and traffic is being impeded.

(3) The spring brake chambers will be caged as follows:

(a) First, make sure the parking brake control release valve is engaged and the wheels are properly chocked before releasing/caging the springs in the spring brake chambers.

(b) Next, remove the dust cap/rubber plug from the brake chamber to be caged and place the item in the map compartment so it won't get lost. Be sure to inform maintenance personnel as to the location of the item for reinstallment after the brake system is repaired.

(c) After removal of the cap, inspect the inside of the chamber to ensure it is free of debris. If the chamber is clogged with mud, sand, or dirt, do not attempt to cage the brake chamber unless the chamber can be cleared.

1 Air pressure may be used to clean out a clogged spring brake chamber.

2 If the chamber cannot be cleaned out with air pressure, do not attempt to clean it out by removing the rim clamp bolt or nut and separating the chamber halves. High pressure inside the brake chamber will cause injury or death if released.

3 If the chamber cannot be cleaned out, replace the dust cap and notify organizational maintenance personnel of the situation.

(d) Now remove the nut, washer, and release/caging bolt from the storage housing on the brake chamber. Notice that the bolt is threaded on one end and has a "T" at the other end.

(e) Insert the T-end of the release/caging bolt into the hole in the top center of the brake chamber and position it into the key-way of the metal diaphragm inside the brake chamber.

(f) With the T-end of the bolt inserted in the key-way, turn the release/caging bolt one-fourth of a turn clockwise until the T-end of the bolt catches on a stop inside the brake chamber.

(g) Now pull on the bolt to make sure it is firmly holding in the diaphragm within the chamber. If the bolt cannot be pulled directly out of the spring brake chamber after it has been turned, the bolt is properly seated.

(h) With the release/caging bolt properly seated, install the washer and nut on the bolt. Tighten the nut finger tight until it comes in contact with the washer on top of the spring brake chamber.

(i) The length of the threaded end of the release/caging bolt extending out of the chamber must be measured with a ruler. The proper length of the bolt when the chamber is fully caged is three inches for the M939 series vehicles and two and one-half to three inches for the LVS when measured from the top of the nut to the end of the threaded end of the bolt.

(j) Finally, turn the nut clockwise on the release/caging bolt until the proper length is obtained. Repeat this procedure with all spring brake chambers.

2. PROCEDURES FOR RECOVERING VEHICLES. In any recovery operation, the following eight steps should be used to make the recovery task less time consuming and as easy as possible.

a. Reconnoiter the Area

(1) Check the terrain for an approach to the load; then determine the method of rigging and the availability of natural anchors. As with any tactical mission, a recovery crew must know the problem before making decisions.

(2) A complete ground survey of the area should be made and then the best route of approach to the disabled vehicle should be selected to prevent possible disablement to the recovery vehicle.

b. Estimate the Situation

(1) Estimate the resistance created by the load and determine the capacity of the available effort. For most recovery operations involving winching, the available effort would be the maximum capacity of the winch.

(2) In some recovery operations, the maximum distance between the winch and the disabled vehicle could be restricted, making the available effort as little as half the winch capacity.

c. Calculate the Ratio. Compute an estimated mechanical advantage (MA) for the rigging by dividing the resistance of the load by the available effort (AE), winch capacity. Always round off the number.

d. Obtain Resistance. Compute the tackle resistance and the total resistance.

e. Verify the Solution

(1) Compute the line forces to compare with the winch and deadline capacities, and divide the total resistance by the mechanical advantage. The result is the force of the fall line. The fall line force must be less than the capacity of the effort. This step in the recovery procedure is the key step to solving the problem.

(2) When verifying the solution, if the computed fall line force is greater than the effort, the mechanical advantage must be increased. Note that no physical work has taken place up to this point. As a result, no time is lost in moving equipment or having to reerect rigging equipment. Compute the deadline force, determine the required strength of equipment capacity, and choose the correct equipment to use as deadlines.

f. Erect Rigging

(1) First, orient the crew, they should be instructed to assemble the tackle and then move to a safe location. Advise the crew members of the plan, direct them to erect the tackle, and assign specific tasks.

(2) Next, inform the crew members who have finished their task to assist those who are having difficulty. The crew members can save time by having a thorough knowledge of the tackle to be erected and by helping each other.

(3) Finally, and most important, make sure all safety precautions are observed.

g. Recheck Rigging

(1) First, make sure that the tackle is rigged for proper and safe operation. Direct the operator to remove the slack from the lines and to inspect for correct assembly. If any corrections must be made, direct the crew members to make them.

(2) Next, explain the actions of the operation to the operators of the recovery vehicle and the other vehicle(s) involved.

(3) Now, the operators should be prepared to act on prearranged signals, and move to a safe location where signals can be observed by all participating in the recovery operation.

h. You Are Ready. The operators should be signaled to apply winch power to recover the load. All personnel involved in the recovery operation should be on the alert and make sure that nothing obstructs the operation of the equipment, and that all are in a safe location.

3. COMPUTING THE TOTAL LOAD RESISTANCE

a. Resistance is the force that tends to oppose or retard motion. In recovery operations, resistance is caused most often by terrain conditions such as mud, sand, water, or the recovery tackle itself.

b. Types of Resistance

(1) Grade resistance

(a) Grade resistance is created when a vehicle moves up a slope and gravity affects the weight of the vehicle.

(b) Grade resistance is estimated as equal to the weight of the disabled vehicle, plus the cargo. Even though the actual grade

resistance may be less than the weight of the vehicle, the most resistance encountered on a grade is the weight of the disabled vehicle and its load.

(2) Overturning resistance

(a) Overturning resistance is that part of the weight of the vehicle which acts against the force exerted to bring the vehicle back on its wheels.

(b) Overturning resistance is estimated at approximately half the weight of the disabled vehicle. Half the weight of the vehicle is the most that will be beyond the center of gravity.

(3) Mire resistance

(a) Mire resistance is created when mud, snow, or sand becomes impacted around the wheels, axle, or cab of the vehicle.

(b) Mire resistance is estimated depending on how deep the vehicle is mired. A vehicle is mired when it is stuck in snow, mud, or sand and can no longer move under its own power. There are three depths of mire resistance.

1 Wheel depth. A vehicle mired up to, but not over, the center of the hub. Estimate the wheel-depth resistance as equal to the weight of the vehicle plus cargo.

2 Fender depth. A vehicle mired from the top of the hub and up to, but not over the fenders. Estimate the fender-depth resistance as twice the total weight of the vehicle plus cargo.

3 Cab depth. A vehicle mired over the fenders or on the cab of the vehicle. Cab-depth resistance is estimated as three times the weight of the vehicle plus cargo.

(c) When estimating the resistance for a mired vehicle that is loaded, estimate the resistance by adding the weight of the load to the weight of the vehicle.

(4) Water resistance. Water resistance occurs when submerged vehicles are pulled from water to land. The amount of resistance met will be estimated the same way as land resistance.

(5) Tackle resistance. Tackle resistance is that part of the total resistance which is added to the recovery by friction in the tackle. Tackle

resistance is estimated as an additional ten percent of the load resistance for each sheave used in rigging.

c. Using a Mechanical Advantage to Overcome Resistance

(1) A mechanical advantage is a small amount of force applied over a long distance to move a heavy load a short distance. A mechanical advantage is the multiplication of force.

(2) A mechanical advantage is needed whenever the load resistance is greater than the capacity of the available effort.

d. Computing the Mechanical Advantage (MA)

(1) To determine the amount of mechanical advantage necessary in a recovery operation, divide the load resistance (LR) and the vehicle weight plus cargo by the available effort (AE) (winch capacity), and round any fraction up to the next higher number.

(2) The mechanical advantage is the only item in the recovery application that is rounded to a whole number. Rounding up is required because only whole numbers can be rigged.

e. Computing the Resistance of a Tackle

(1) A tackle is a combination of ropes or cables and blocks used to gain a mechanical advantage or to change the direction of pull. The tackle is classified as simple or compound.

(a) The simple tackle is one rope or cable with one or more blocks. Since the winch has only one cable, the simple tackle will almost always be used for recovery operations.

(b) The compound tackle is more than one rope or cable used with two or more blocks. The compound tackle is a series of two or more simple tackles. The output of one simple tackle is used as the effort for the other.

(2) Computing tackle resistance

(a) Friction created by a tackle sheave rotating on its pin, the rope flexing around the sheave, or the rope scuffing in the groove of the sheave causes a loss in energy as the rope passes around the sheave. This loss is resistance and must be overcome before the resistance of the load can be overcome. Each sheave in the rigging will create resistance.

(b) To determine the tackle resistance, multiply ten percent of the load resistance by the number of sheaves in the rigging.

f. Total Load Resistance. Since tackle resistance must be overcome before a load resistance can be moved, the two resistances (load and tackle) are added. This resistance is the total resistance that the available effort must overcome.

4. IDENTIFICATION OF SAFETY REQUIREMENTS FOR VEHICLE RECOVERY OPERATIONS

a. Handling Cables and Wire Ropes

(1) Cables and wire ropes may become damaged through normal or improper use. The wires that make up the strands of the rope may break through normal operation.

(2) Make sure when handling wire ropes to always wear heavy, leather-palmed gloves to prevent injuries or cuts to your hands from broken wires.

(3) Never let a moving cable slide through your hands even when you are wearing gloves since broken wires can cut through the gloves.

b. Positioning of the Hook

(1) When rigging for recovery, the hook should be positioned with the open part (throat) upward. If the hook should straighten out from an overload, the rigging would be forced downward.

(2) If the hook was positioned with the open part down, the rigging would travel upward unrestrained and cause serious injury to personnel and damage to equipment.

(3) When using pins with safety keys, such as the type in some tow bars, all pins in a vertical plane should have their heads pointing up. Then, even if the safety key should break or fall out, the pins will remain in position if the load shifts.

c. Placement of Safety Keys in Shackle Pins

(1) Some shackles use a threaded-type pin. If the pin is not completely threaded into the shackle part, the shackle or pin can be bent or broken when force is applied.

(2) Safety keys should be in place on all tow hooks, shackles, or other items of rigging equipment requiring them. Even though the safety key

supports no great load, its absence can allow a pin to move and place an excessive force on only a part of a connection.

d. Rigging Between Vehicles

(1) When rigging is being erected between vehicles, turn the engines off on all vehicles and apply the parking/emergency brakes. This prevents possible injury to the rigging personnel or damage to the vehicles.

(2) When riggings are erected using a recovery vehicle that must have its engine running to operate the equipment, the driver will remain in position in the vehicle, the wheels will be chocked, and the brakes applied to prevent movement of the recovery vehicle.

e. Inspecting Rigged Equipment

(1) All rigging equipment used in the recovery operations should be inspected thoroughly before the recovery operation starts.

(2) The recovery vehicle operator should be directed to apply power to the winch to remove the slack from the rigging cable, then the operation should be stopped so the rigging can be inspected without endangering personnel.

f. Safety Precautions

(1) Inspection of rigging for crossed cables

(a) Before the winching operation is continued, make sure the rigging lines are not crossing each other. Crossed rigging lines can rub against each other causing damage to the cables and increase the amount of tackle resistance.

(b) Crossed cables are only recommended for towing, not recovering disabled vehicles.

(2) Inspection for the spillage of fuel or oil

(a) If fuel or oil has spilled from the disabled vehicle, there must be NO SMOKING and NO OPEN FLAMES. Make sure the exhaust flash from other vehicles is not directed at the vehicle with spilled fuel or oil.

(b) Make sure that spilled fuel or oil is thoroughly cleaned up before attempting to start the engines of the vehicles used in the recovery operation.

(c) When winching or lifting a disabled fuel carrier, thoroughly ground the vehicle to keep static electricity from igniting the fuel. The fuel carrier should have the grounding equipment needed.

(3) Acceleration impact. Do not apply loads suddenly. This puts excessive strain on the equipment and it may fail. Failure of the rigging equipment occurs when a weight is allowed to fall for a distance and is suddenly stopped. A similar strong force occurs when power is engaged suddenly.

(4) Avoidance of backlash

(a) Make every effort to stand clear of any wire rope that is under tension. When a wire rope is drawn taut and then released suddenly by a break, its recoil (or backlash) will cut a person in two or damage equipment.

(b) A broken winch cable snapping back could be compared with a rifle bullet except the bullet makes a fairly clean hole and the winch cable makes a messy wound.

(c) Wire rope under stress should be treated with the same respect you would a loaded rifle.

(5) Employment of the ground guide

(a) For safe control of a recovery operation, there should be nly one ground guide. To prevent confusion, the ground guide should stand separately from other personnel at the recovery site and where operators can easily observe the signals.

(b) The operators in the recovery operation must know the meaning of the signals to be used and act only on the signals given by the ground guide.

(6) Operator/driver safety. Operators and other personnel, in both the recovery and disabled vehicles, should keep their doors closed and windshields in place and be observant of all signals.

5. RECOVERING A VEHICLE USING MECHANICAL AND NATURAL ANCHORS

a. Vehicles used in a recovery operation frequently may have to use a rigid point of support when moving heavy loads with winch and tackle(s). An anchor can assist in holding the recovery vehicle, in providing a change in the direction of pull, or in supporting part of the load during a recovery operation.

b. There are two types of anchors, natural and mechanical, that can be used in the recovery of a disabled vehicle.

(1) A natural anchor is an anchor that does not have to be constructed. Examples are trees, tree stumps, large rocks, or other vehicles. Avoid dead or rotten trees or stumps and rocks that are not large enough or embedded firmly in the ground.

(a) A vehicle can be used as an anchor to assist in the recovery of a mired vehicle with a winch.

1 The winch cable of the mired vehicle is extended to the anchoring vehicle and the mired vehicle winches itself out.

2 The anchoring vehicle should not attempt to pull; it is only an anchor. This eliminates the chance of damage to the winch.

(2) There are several types of mechanical anchors. The type constructed depends on the holding ability requirements, the type of soil, availability of materials, and the situation.

(a) A picket holdfast is constructed by using two or more sound wooden pickets at least three inches in diameter and five feet long.

1 The pickets should be driven about three feet into the ground, three to six feet apart, and in line with the deadline.

2 The pickets should be tied together with a fiber rope by first tying one end of the rope to the top of the front picket with a clove hitch. Then make four to six wraps of the rope, starting from the top of the front picket to the bottom of the rear picket, and tie the other end of the rope to the bottom of the rear picket with a clove hitch.

3 Finally, pass a stake between the rope wraps midway between the pickets, tighten the rope by twisting it with the stake, then drive the stake into the ground. Repeat this operation for each successive pair of pickets.

4 The strength of the picket holdfast depends mainly on the first, or front picket. To reinforce it, drive two or more pickets into the ground close to the front picket. Tie them together before tying to the rear picket.

(b) A sand parachute is used as an anchor in a sandy area with no trees.

1 Dig a large, deep hole and line it with a tarpaulin.

2 The tarpaulin is then filled with the sand removed from the hole, the four corners are lashed together, and the rigging is attached.

3 The sand parachute has limited holding ability and should not be used when a major effort is required.

(c) A scotch anchor is used to anchor a truck during a winching operation when natural anchors are not available.

1 First, select a log at least six inches in diameter and two feet longer than the vehicle is wide.

2 Dig a shallow trench about three to four inches deep parallel to the front axle, just ahead of the front wheels.

3 Next, lay a tow chain or a couple of chains, across the trench, place the log in the trench, and move the vehicle forward until both front tires are against the log.

4 Finally, attach both chain ends to the lifting shackles and remove all slack from the chain.

5 As power is applied to the winch, the front wheels are pulled onto the log, pulling the chain taut and anchoring the vehicle.

(d) The log deadman is one of the best types of constructed anchors and can be used for heavy loads. It consists of a log, timber, steel beam, or other similar objects buried in the ground with a deadline connected to it at the center. To construct a log deadman, the following steps must be completed:

1 First, select a place where the direction of pull is as nearly horizontal as possible, such as a sharp bank or crest. You can obtain more holding power with less digging.

2 Next, when digging, slant the trench at least fifteen degrees from the vertical and undercut towards the disabled vehicle.

3 When the digging is complete, lay the deadline over the trench, lay the deadman in the hole over the deadline, and drive the stakes in front of the deadman at each end to hold it in place.

4 Next, tie the deadline to the center of the deadman so the main or standing part of the line leads from the bottom of the

deadman. Dig a narrow trench for the deadline, bearing to the deadman. If the deadline has a tendency to cut into the ground, place a log or plank under the line at the outlet from the inclined trench.

5 Now, tie the deadline to the center of the deadman so that the main part of the line leads to the bottom of the deadman. This will prevent the deadman from rotating out of the hole.

6. THE M1038 WINCH CHARACTERISTICS AND OPERATION

a. M1038 Vehicle Winch Characteristics and capabilities

(1) The M1038 is equipped with an electrical winch that is powered by the vehicle's electrical system.

(a) the winch is equipped with an electronic current limiter switch to prevent winch overload. If the winch stops repeatedly during operation and restarts in approximately five seconds, the current limiter is being activated, indicating an overload condition.

(b) The electronic winch is also equipped with a thermal cut-off switch to prevent the winch from over heating.

1 If the winch stops during operation, and does not restart within five seconds, wait approximately two minutes to let the winch cool off and allow the thermal switch to reset.

2 If the winch is still inoperative after five minutes, notify unit maintenance per established SOP.

(2) The listed maximum capacity for the M1038 front winch is 6,000 pounds.

(3) The winch employs one-hundred feet of three-eights inch diameter wire rope/cable.

b. Nomenclature and Purpose of the M1038 Winch Components

(1) The manually operated clutch lever, located at the right front of the winch, when turned counterclockwise will place the winch in the free spool position, and when turned clockwise will engage the winch.

(2) The remote control switch with electric cable, located in the stowage box on the left side of the winch, operates the winch motor to turn the winch in and out.

(3) The cable guide at the front of the winch is used to control the winch cable during winching operations.

c. Operation of the M1038 Winch

(1) Preparation of the winch for use.

(a) First, park the vehicle directly facing the vehicle to be winched, and place the transmission in "N" (neutral).

(b) Next, apply the parking brake.

(c) If the engine is running leave it on, if not start the engine.

(d) Now chock the wheels of the winching vehicle to prevent it from moving during the winching operation.

(2) Unwinding the winch cable.

(a) First, turn the clutch lever counterclockwise to "FREE SPOOL."

1 Do not power out the winch cable for more than ten feet.

2 Free spooling should be used for paying out long lengths of winch cable to prevent damage to the winch.

3 Make sure that four wraps of winch cable remain on the drum at all times when fully extending the winch cable. Failure to do so may cause injury or death to personnel.

4 To allow for winch motor startup for maximum pulling power, allow one foot of slack in the winch cable prior to starting winching operations.

(b) Now, connect the winch cable to the load.

(3) Using the M1038 winch to pull a load.

(a) First, direct all personnel to stand clear of the winch cable during the winching operation.

(b) Next, remove the control switch from the stowage box.

(c) Now, turn the clutch lever clockwise to the "ENGAGE" position.

(d) With the clutch lever in the engaged position, pull out the hand throttle until the desired engine speed is obtained. Do not fully apply the hand throttle during an engine "NO LOAD" condition.

(e) Now, operate the remote control switch "IN" or "OUT" until the vehicle has been retrieved.

(4) Securing the M1038 winch after operation.

(a) First, wind the winch cable onto the drum until the hook is four feet from the cable guide. The winch cable must be wound on to the drum under a load of at least five-hundred pounds or the outer wraps will draw into the inner wraps damaging the winch cable.

(b) Next, turn the clutch lever counterclockwise to the "FREE SPOOL" position, and rotate the drum by hand to retrieve the remaining cable.

(c) Now, place the remote control switch in the stowage box, and turn the clutch lever clockwise to the 'ENGAGED' position.

(d) Finally, release the hand throttle and turn off the retrieving vehicle's engine.

7. THE M813 FRONT WINCH CHARACTERISTICS AND OPERATION

a. M813 Vehicle Winch Characteristics and Capabilities

(1) The M813 vehicle is equipped with a transmission driven power takeoff (PTO) front mounted winch.

(2) The maximum single part line pull for the winch is 20,000 pounds.

(3) The winch also has an internal automatic safety break designed to hold the winch load when the PTO is shifted or the power to the winch is interrupted.

b. Nomenclature and Purpose of the M813 Front Winch Components

(1) The drum lock knob located on the left side of the winch is pushed in to lock the winch drum when not in use and pulled out and turned one-quarter turn to unlock the winch drum when the winch is in use.

(2) The drum clutch lever located on the left rear portion of the winch is pulled away from the winch to engage the winch and pushed in to disengage the winch.

(3) The front winch control lever located in the cab, center on the floor, is pulled back to wind the front winch and pushed forward to unwind the winch.

(4) The power divider control lever, located to the left of the vehicle operator's seat, is pushed forward to provide power to auxiliary equipment (winch) and pulled rearward to disconnect the power source.

(5) The winch is connected to the PTO by a drive shaft which is secured to the winch input shaft by an aluminum shearpin.

(a) Never substitute the aluminum shearpin with rivets, pins, bolts, or nails. The use of these items will result in damage to components.

c. Operation of the M813A1 Front Winch

(1) Preparation of the winch for use.

(a) First, start the vehicle engine.

(b) Next, park the vehicle directly facing the vehicle to be winched, place the gearshift lever in the "N" (neutral) position, and engage the parking brake by pulling it up.

(c) Now pull the drum lock all the way out, turn it one-quarter turn, and release it. This will allow the drum to turn freely so that the cable can be pulled out.

(2) Unwinding the winch cable.

(a) First, engage the drum jaw by moving the drum clutch lever away from the winch.

(b) Next, unhook the winch cable chain hook from the right lifting shackle and pass the hook through the left lifting shackle.

(c) Now pull the winch cable chain hook down and under the center of the front bumper.

(d) With the winch cable chain hook free, pull the cable hook until enough cable has been unwound to reach the load that is to be pulled.

1 Leave at least four turns of the cable on the drum. The cable clamp screw by itself will not hold the cable around the drum when a load is being pulled.

2 To stop the cable from unwinding too fast, an internal drag brake is installed in the winch.

(3) Using the M813 winch to pull a load.

(a) First, depress the clutch pedal, lift the hinged locking plate on the floorboard and pull the winch control lever into the wind position, and push the transfer control lever in the "L" (low) position.

(b) Now make sure the transmission gearshift lever is in the "N" (neutral) position.

(c) The winch operating speed can be regulated by either depressing the accelerator pedal or pulling out the hand throttle control handle.

(d) Do not operate the winch at excessive or erratic speeds, which may cause an overload, resulting in a broken winch shearpin.

8. THE M925 WINCH CHARACTERISTICS AND OPERATION

a. Characteristics and Capabilities

(1) The M925 is equipped with a hydraulic powered front winch.

(a) The winch is powered by a hydraulic system that converts mechanical power from the engine into fluid power by the use of a hydraulic pump, and back into mechanical power at the winch drive motor.

(b) The transmission power takeoff (PTO) provides the driving power to the hydraulic pump.

(c) The winch motor converts the hydraulic power into mechanical power as this hydraulic oil is forced, under pressure, through worm gears in the winch motor. This action rotates the winch drum.

(2) The most important single item in vehicle recovery is the wire rope. The front winch on the M925 employs 200 feet of 5/8 inch wire rope that we commonly call a cable. Wire rope is made of many wires, usually plow steel for winches. These strands are twisted together around a core to make the wire rope.

(3) The listed capacity for the winch is 20,000 pounds. Do not attempt to recover vehicles that weight over 20,000 pounds with this winch using a straight line pull.

b. Preparation of the Vehicle

(1) Position the vehicle. First, we need to position the vehicle for winching.

(a) Park the vehicle directly facing the direction of the pull, if possible. A direct pull provides less resistance on the cable.

1 If the vehicle cannot be lined up in a direct line with the load, line the vehicle up with a strong go-between object, such as a large tree.

2 The winch cable is then run to this go-between object, placed through a snatch block, then on to the load.

(b) Place the transmission in "N" (neutral) and apply the parking brake.

(2) Next, turn the ignition switch and battery switch to the "OFF" position.

(3) Now, check the oil level in the hydraulic oil reservoir. The reservoir is located on the right side of the vehicle between the tool box and the rear tires. Remove the filler cap and pull out the dipstick. The oil level must be above the red area of the dipstick.

c. Unwinding the Winch Cable. The next step is to unwind (pay out) the winch cable. There are two methods for doing this.

(1) The first method is called "freewheeling." This method must be used if there is only one individual present to do the winching. It is also used when a lot of cable is needed, or when the entire cable is stretched out to clean it. To use this method:

(a) Free the winch cable chain and hook from the vehicle bumper and lifting shackles.

(b) Pull out the drum lock knob, rotate it 90 degrees in either direction, then release the knob.

(c) Grab the chain hook and simply pull out as much cable as you need. Don't pull to fast or the cable may try to kink or knot.

(d) The winch drum will continue to be freewheeling until the drum lock is placed in the locked position or the winch clutch is engaged.

(e) Don't pull out the entire cable unless you are changing cables. Always leave at least four turns of the cable on the drum. This will prevent you from pulling the cable from the drum.

(2) The other method used to pay out the cable uses the vehicle's power and requires two individuals, one to operate the controls and one to handle the cable. This method is used primarily when just a short length of cable is required or when the operator wants to keep the cable wound tight around the drum. To use this method:

(a) First, free the winch cable chain and hook from the bumper and lifting shackles.

(b) Pull out the drum lock knob, rotate it 90 degrees in either direction, then release the knob.

(c) Release the hinged latch and pull the clutch lever in the direction away from the winch as far as it will go.

(d) Make sure the transfer case shift lever is in high range.

(e) Make sure the parking brake is set and start the vehicle's engine.

(f) Place the transmission selector in "1-5" (drive) and pull the transmission power takeoff control lever back to "ENGAGE." Then return the transmission selector lever to "N" (neutral).

(g) Direct the cable handler to maintain tension on the cable to prevent it from kinking.

(h) Push the front winch control lever forward to "UNWIND" and hold.

(i) The winch speed and capacity is regulated by the engine rpm. To increase the speed, depress the accelerator pedal or adjust the hand throttle control.

(j) When the desired amount of cable is payed out, release the winch control lever and it will return to neutral.

d. Rewinding the Winch Cable. The procedures are the same if you are rewinding a cable after cleaning it or pulling a load. The rewinding

procedures require two individuals, one to operate the controls and one to manipulate the cable.

(1) The first step is to start the engine.

(2) Pull the clutch lever as far in the direction away from the winch as it will go. This will have to be done only if the freewheeling method was used. Otherwise, it will be in this position.

(3) Engage the PTO. It will be engaged, unless the freewheeling method was used.

(4) Pull the winch control lever back to the "WIND" position and hold it there for winding or pulling. Wind the cable slowly.

(5) The other crew member will guide the cable onto the drum with a piece of wood, making sure each layer of cable is wound on the winch drum evenly.

(6) If a disabled vehicle is being recovered, make sure the cable is not guided onto the winch drum. All personnel on the ground should be a safe distance away from the cable, in case the cable should break.

(7) If the temperature is above 70 degrees Fahrenheit, stop the winding operation by releasing the winch control lever after every 100 feet of cable has been winched in. Stop the operation for six minutes. During this period of time, leave the truck engine idling and the power takeoff control lever engaged. Failure to do this may cause damage to the winch. Resume winding after six minutes.

(8) Release the winch control lever just before the chain reaches the winch drum. The crew member handling the cable will signal this.

(9) The crew member will maintain manual tension on the cable and disengage the drum clutch by pushing the clutch control lever toward the winch. Do not force the clutch control lever. If it does not easily disengage, slightly engage the winch control lever in "WIND" until the clutch can be disengaged without force.

(10) Swing the hinged latch down to lock the clutch control lever in the disengaged position.

(11) Pull out and rotate the drum lock 90 degrees to the lock position. You may have to rotate the drum slightly to ensure the lock plunger engages.

e. Preparing the Winch Cable for Travel

(1) First, run the winch cable chain and hook under and over the right frame extension, then across the top of the right bumper.

(2) Next, remove the right towing shackle by unsnapping the safety key and removing the shackle bolt.

(3) Now, place the towing shackle over the chain and reinstall the shackle.

(4) Finally, attach the cable hook to the left towing shackle.

9. TOWING OF MARINE CORPS MOTOR TRANSPORT VEHICLES

a. The towing of motor transport vehicles outlined in this lesson will be the flat tow method using a tow bar. Tow bars can be found on either the wrecker recovery vehicle or in the Common No. 1 Tool Kit.

b. Flat Towing of the M939 Series Vehicles.

(1) Safety procedures.

(a) First, make sure that no personnel are riding in the towed vehicle.

(b) Do not use towing to start the engine of any vehicle with an automatic transmission.

(c) Make sure that the transmission, transfer case, and power take-off (PTO) of the towed vehicle are in the "N" (neutral) position. Placing these components in the neutral position will prevent the transmission of the towed vehicle from being damaged.

(d) If the compressed air system of the towed vehicle is inoperative, cage the spring brakes. Caging the brakes will cause the brake to release and prevent the wheels from dragging.

(e) Do not connect the emergency and service air lines of the compressed air brake system of the towed vehicle if the system is inoperative. If the air lines are connected, the equipment may be damaged and someone may be injured or killed.

(f) During normal towing procedures where nothing is wrong with the power plant of the towed vehicle, removal of the drive shaft is not required.

(2) Towing the M939 series vehicle.

(a) First, remove the lifting shackles from the front bumper of the towed vehicle and stow the shackles in a safe place.

(b) Next, adjust the tow bar to the fully collapsed position, and install the clevis end of the tow bar to the front bumper shackle brackets and secure them in place with the clevis bolt and safety pin.

(c) With the tow bar secured to the towed vehicle, install the yoke end of the tow bar to the pintle hook of the towing vehicle and install the safety pin.

(d) Now install the chains loosely through the front springs of the towed vehicle, crisscross the chains and connect them around the frame of the towing vehicles. The chains should be clear of any lifting brackets or wiring.

(e) With the chains properly installed, connect the emergency and service air lines to the half couplings on each vehicle.

(f) Now release the parking brake and place the transmission, transfer case, and PTO in the neutral position on the towed vehicle.

(g) Finally, turn on the hazard warning lights on both vehicles.

c. Flat Towing of the M809 Series Vehicle

(1) Safety precautions.

(a) Any M809 series vehicle with an inoperative brake system will only be towed with a tow bar.

(b) Vehicles with compressed air in the air reservoir may be towed with a tow bar, tow chain, or tow cable if the towed vehicle has at least seventy-five pounds per square inch (psi) on the air pressure gauge, indicating that enough pressure is in the air reservoir to operate the service brakes.

(2) Towing the M809 series vehicle.

(a) The first step in preparing a M809 series vehicle for flat towing is to fully collapse the tow bar and connect the tow bar to the towed vehicle's lifting shackle bracket and the towing vehicle's pintle as was previously instructed on the M939 series vehicle.

(b) Next, connect one end of the safety chains to the spring hangers on the towed vehicle, crisscross the chains, and connect the other end to the towing vehicle.

(c) Now, connect the air brake system of the towing vehicle to the intervehiclar couplings located under the front fender of the vehicle that is being towed.

(d) With the intervehiclar cable connected, turn on both the service and emergency brake shutoff valves on both vehicles. Failure to turn on the air shutoff valves will result in the loss of brakes on the towed vehicle.

(e) Now depress the clutch on the towed vehicle and place the transmission and transfer case in the neutral position.

(f) Finally, release the parking brake of the towed vehicle.

d. Flat Towing the M998 Series Vehicle

(1) Safety precautions.

(a) Do not exceed a towing speed of thirty miles per hour or a towing distance of thirty miles without first removing the front propeller shaft and the rear propeller shaft with the parking brake rotor. Failure to remove the shafts will result in damage to the transmission and transfer case.

(b) Always use a tow bar when towing a M998 series vehicle, never use a tow chain and tow cable.

(2) Towing the M998 series vehicle.

(a) First, attach the tow bar to the towing shackle brackets of the vehicle to be towed and the pintle hook of the towing vehicle.

(b) Next, attach the safety chain to the vehicle frame directly behind the bumper on the towed vehicle and the bumperette on the towing vehicle. Crisscross the safety chains and let them dip about one foot from the ground.

(c) Now place the transmission and transfer case shift levers in the "N" (neutral) position.

(d) Finally, release the parking brake. On the new configurations, the parking brake button must be depressed before the parking brake lever can be moved to release the parking brakes.

e. Flat Towing the Logistics Vehicle System (LVS)

(1) Safety procedures.

(a) Never prepare a disabled vehicle for flat towing until the vehicle has been safely rigged the towing vehicle.

(b) Do not use tow straps or cross chains to flat tow a LVS. If these items are used, personnel may be injured or the equipment could become damaged.

(c) Do not exceed a five mile per hour speed limit or one half mile distance without disconnecting the vehicle's drive line. If these limits are exceeded, damage to the vehicle transmission will occur.

(d) When towing a disabled LVS, a speed limit of fifteen miles per hour will NOT be exceeded.

(e) Never rig an LVS Front Power Unit for flat towing if it is uncoupled from its trailer unless it is safely secured to prevent tipping.

(f) Except in an extreme emergency condition, do not flat tow an LVS without first disconnecting and securing the vehicle drive line.

(g) If using a vehicle other than the LVS wrecker for towing, the wrecker's heavy duty tow bar, short and long lifting chains, and air lines will must be used.

(h) If the disabled vehicles air system is inoperative, the brakes of the disabled vehicle must be caged.

(2) Towing the LVS.

(a) First, position the towing vehicle directly inline with the front of the disabled vehicle; allowing adequate space for working.

(b) Next, place the towing vehicle's transmission shift lever in neutral and apply the parking brake valve.

(c) Being very careful because the tow bar is extremely heavy, fully extend the tow bar and secure the tow bar brace to the tow bar with pins and retaining pins.

(d) Now, install the clevis of the tow bar in the upper tow eyes of the towed vehicle, and secure the assembly with the pins and retaining pins.

(e) Using two crew members to lift and hold the tow bar in position for coupling with the pintle hook at the rear of the towing vehicle, direct the towing vehicle slowly backwards until the eye of the tow bar can be installed on the pintle hook.

(f) With the tow bar resting on the pintle, close and lock the pintle hook.

(g) Now, attach the two short lifting chains to the tie down/lifting brackets at the rear of the towing vehicle using shackles and pins.

(h) Next, install the two long chains to the front power unit of the towed vehicle through the lower toe eyes using shackles and pins.

(i) With the chains connected to the vehicles, cross the long and short chains over each other, and connect the grab hook of the short chains to the second link below the grab hook ends of the long chains.

(j) Now install the two small shackles on the long lifting chains so that the chains will not come apart during the towing operation.

(k) If the disabled vehicle's brake system is operable, connect the air lines between the two vehicles.

1 First, connect the air lines to the glad hands at the rear of the towing vehicle.

2 Next, insert the air lines through the front grille of the disabled vehicle and wrap them about 2 1/2 times to prevent the lines fron dragging on the ground.

3 Now connect the air lines to the front glad hands of the disabled vehicle, service-to-service (blue-to-blue) and emergency-to emergency (red-to-red).

(l) With the air lines properly connected, open the ball valve to release the disabled vehicle's parking brakes.

(m) Finally, place the disabled vehicle's transmission shifter in Drive-3, the transfer case shifter in low range, and push the parking brake valve in to release the parking brake.

REFERENCES

FM 21-305, Manual for Wheeled Vehicle Operators
FMFRP 4-34, Recovery and Battlefield Damage Assessment and Repair
Applicable Equipment Technical Manuals